CLAIMS

1. A measuring device for determining concentration of a first material in an environment in contact with the device, which first material reacts within said device in presence of a catalyst with a second material to form a third material; and which device comprises:

a membrane comprising a body, a surface in contact with said environment, and at least one discrete hydrophilic region in communication with said body, wherein said hydrophilic region is permeable to said first and second materials, and said body is otherwise permeable to said second material and essentially impermeable to said first material, wherein both said first and second materials diffuse into said device from said environment through said surface;

a catalyst within said hydrophilic region wherein reaction of said first and second materials occurs;

at least one critical zone within said hydrophilic region containing said catalyst;

at least one sensor, having a surface communicating with at least one said hydrophilic region and sensitive to either said second material or said third material and producing a signal indicative of the concentration of said second or third material in said region; and

a control responsive to said signal for comparing said signal to a reference to determine the concentration of said first material in said environment.

2. The measuring device of claim 1, wherein the environment is mammalian tissue.

3. The measuring device of claim 1, wherein the environment is a biological fluid.

4. The measuring device of claim 1, wherein the environment is contacted by implantation of the sensor into an individual.

5. The measuring device of claim 1, wherein the bodily fluid is removed from an individual for contact with the sensor outside of the body.

6. The measuring device of claim 1, wherein the first material is glucose.

7. The measuring device of claim 6, wherein the catalyst is glucose oxidase.

8. The measuring device of claim 1, wherein the first material is lactate.

9. The measuring device of claim 8, wherein the catalyst is lactate oxidase.

10. The measuring device of claim 1, wherein the first material is cholesterol.

11. The measuring device of claim 10, wherein the catalyst is cholesterol oxidase.

12. The measuring device of claim 1, wherein the second material is oxygen.

13. The measuring device of claim 1, wherein the third material is hydrogen peroxide.

14. The measuring device of claim 1, wherein the membrane body is selected from the group of materials consisting of silicone-containing, ethylene-containing and propylene-containing polymers with and without fluorine, silicone rubbers, polyethylene, polypropylene, teflons and polyfluorinated hydrocarbons, poly-methylmethacrylates, poly-carbonates, poly-hydroxyethylmethacrylate, and co-polymers and combinations thereof.

15. The measuring device of claim 1, wherein the hydrophilic region is selected from the group of materials consisting of polyacrylamide gels, gluteraldehyde cross-linked proteins, vinyl pyrollidone, alginates, ethylene oxide, acrylamide, methylacrylic acids, polyhydroxyethyl-methacrylate and its derivatives, and co-polymers and combinations thereof.

16. The measuring device of claim 1, wherein the hydrophilic region has essentially an identical surface area on the inner and outer faces of the membrane.

17. The measuring device of claim 1, wherein the hydrophilic region has a larger surface area on the inner face of the membrane as compared to the outer face of the membrane.

18. The measuring device of claim 1, wherein the membrane contains a plurality of hydrophilic regions.

19. The measuring device of claim 18, wherein the plurality of hydrophilic regions are a variety of sizes.

20. The measuring device of claim 1, wherein an average vector direction of diffusion of said first material in said critical zone is

substantially parallel to an average vector direction of diffusion of said first material in said hydrophilic region.

21. The measuring device of claim 1,comprising a critical zone with an average equivalent radius and a length, wherein said average equivalent radius of said critical zone is less than said length of said critical zone, wherein said equivalent radius is obtained by dividing the cross-sectional area of said critical zone by pi and then taking a square root of the resulting quantity.

22. The measuring device of claim 1, wherein an average vector direction of diffusion of said first material in said critical zone is substantially parallel to an average vector direction of diffusion of said first material in said hydrophilic region and an average equivalent radius and a length, wherein said average equivalent radius of said critical zone is less than said length of said critical zone, wherein said equivalent radius is obtained by dividing the cross-sectional area of said critical zone by pi and then taking a square root of the resulting quantity.

23. The measuring device of claim 1, wherein the critical zone is coincident with the hydrophilic region.

24. The measuring device of claim 1, wherein a single hydrophilic region corresponds to more than one sensor.

25. The measuring device of claim 1, wherein the base of the hydrophilic region is nearly identical in area to the area of its corresponding sensor.

26. The measuring device of claim 1, wherein the base of the hydrophilic region is larger in area than its corresponding sensor.

27. The measuring device of claim 1, wherein more than one hydrophilic region corresponds to a single sensor.

28. The measuring device of claim 1, wherein a single hydrophilic region corresponds to a plurality of sensors.